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Original Research Paper

Radiological Imaging in Pulmonary Embolism

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ABSTRACT:
This study aimed to compare the demographic data, co-morbidity profiles and clinical presentation of patients with peripheral or central pulmonary edema. The total number of patients of a hundred was arrived at with fifty patients in each of the two groups. The peripheral and central edema patient groups in the study had median ages of 40 and 45, respectively. Self-efficiency and cholesterol were the two variables that were investigated in the present study, apart from diabetes, myocardial infarction, chronic obstructive pulmonary disease (COPD), and body mass index (BMI). In the present study, the BMI has been compared in the two groups using the Mann-Whitney U test in which the p value of 0.021 indicates that the two groups are significantly different. Analyzing the results by multiple regression, it was found that the presence of pulmonary edema can be explained by age (p = 0.011) and the presence of chronic obstructive pulmonary disease (COPD) (p = 0.044). In the analysis of variance, these relationships regarding age and comorbidities such as diabetes (p=0.034), myocardial infarction (p=0.025), COPD (p=0.031), and solid tumors (p=0.046) were statistically significant (p=0.040). The outcomes reveal that several patient-specific factors must contribute considerably to the development of both central and peripheral pulmonary edema, such as age, obesity, and several diseases and health conditions.

Keywords: Pulmonary edema, Comorbidities, Body mass index (BMI), chronic obstructive pulmonary disease (COPD), multiple regression analysis

INTRODUCTION:

Venous thromboembolism (VTE) often develops into a potentially lethal condition called acute pulmonary embolism (PE), when untreated. Each year, more than 250,000 people are brought to the hospital because of this health issue, designating it as the third most important cause of death related to cardiovascular disease in the United States [1-3]. With about 60,000 to 100,000 fatalities yearly from VTE, a significant percentage of deaths take place in the first month after diagnosis [4]. Diagnosing and treating PE heavily rely on the use of imaging. Even though CTPA is recognized as the gold standard for pulmonary angiography, it is by no means the only or even the best choice [5,6]. On this page, we analyze the clinical picture of PE, including the significance of imaging in diagnosis, the assorted imaging techniques that are applicable, and the distinct imaging anomalies associated with each. About 1-2 people out of every 1,000 with venous thromboembolism (VTE) will experience acute pulmonary embolism (PE)—a typical reason for chest pain in emergency departments [4]. For individuals with inherited thrombophilias, the danger of VTE is increased, which impacts 5-8% of the US population [4]. Recurrence rates for VTE within a 10-year timeframe can reach as high as 30%, and of that population, about half are likely to develop long-term post-thrombotic syndrome [4].

Up to two-thirds of individuals present with no symptoms, or their initial presentation is a sudden cardiac event, making the clinical presentation of PE vary significantly. Symptoms often seen include chest pain, increased heart rate, low blood pressure, troubles with breathing, cough, or coughing up blood. Individuals presenting with serious cases of pulmonary embolism might show hypotension, shock, or a cardiac arrest. S1Q3 pattern, S1Q3T3 pattern, notched S wave in lead V1, inverted T wave, and right bundle branch block can be shown in people with right heart strain according to ECG findings [7]. The indications of proximal deep vein thrombosis (DVT) include wall diffusion of the lower extremity, erythema, edema, and pain. The Wells score [8] and the Geneva score are used for assessing the clinical risk of PE. A three-tier classification system (0-1: The risk stratification method (low risk; 2-6: moderate risk; >6: high risk) delivers a reliable technique for categorizing risk [9]. A two-tier model (≤4: The study suggests (with the likelihood of PE classified as "PE unlikely" (< 4 : 1) or "PE likely" (greater than 4 : 1)) that a D-dimer test should be conducted on "PE unlikely" patients and a CT angiography (CTA) on "PE likely" patients [10]. The plasma-derived degradation product known as D-dimer has a high sensitivity and negative predictive value for the diagnosis of VTE [11]. A D-dimer test that produces a negative result (<500 ng/mL) in patients of low or intermediate pre-test risk practically confirms there's no sign of acute PE, ruling out the need for further testing. A positive result from a D-dimer test requires CTA as a supplementary examination [10]. For patients aged over 50, the D-dimer cut-off should be broadened to improve specificity, achieved by multiplying their age by 10. A warning is given to patients with sepsis, cancer, pregnancy, myocardial infarction, or recent surgical histories, since these conditions have been linked to false-positive D-dimer results [12].

MATERIALS AND METHODS:

The objective of this investigation was to contrast the demographic factors, health problems, and clinical characteristics of peripheral pulmonary edema in relation to those observed in central pulmonary edema. There were fifty patients (n=50) in each group, with one dedicated to peripheral pulmonary edema and the other to central pulmonary edema. A total of 100 patients into two exact groups were made. Data from patients was gathered, involving age, gender, BMI, and the occurrence of comorbidities (including diabetes mellitus, chronic obstructive pulmonary disease (COPD), and myocardial infarction, etc.). The statistical techniques applied involved the Mann-Whitney U test for analysis of non-parametric variables, multiple regression analysis to identify how predictors shape outcomes, and analysis of variance (ANOVA) to examine the relationship between independent factors (such as comorbidities) and dependent variables (such as body mass index, age). It was found that reaching a statistical significance of a p-value under 0.05 was achieved.

RESULTS:

Table 1: Demography patient characteristics

Characteristics	Peripheral Pulmonary edema (n=50), Group I	Central Pulmonary edema (n=50), Group II	Overall (n=100)
Age [median years with inter-quartile range]	40.0 (30.0–55.0)	45.0 (35.0–60.0)	43.0 (32.5–57.5)
Gender			
Male gender	22 (44.0%)	27 (54.0%)	49 (49.0%)
Female gender	28 (56.0%)	23 (46.0%)	51 (51.0%)
Setting			
Emergency department cases with percentage	20 (40.0%)	30 (60.0%)	50 (50.0%)
Inpatient department cases number with percentage	30 (60.0%)	20 (40.0%)	50 (50.0%)
Body mass index (kg/m²) with median (IQR) values	26.0 (22.0–31.0)	29.5 (25.0–34.0)	28.0 (24.0–33.0)
Comorbidities			
Diabetes mellitus cases	10 (50.0%)	12 (60.0%)	22 (55.0%)
Myocardial infarction cases	3 (60.0%)	2 (40.0%)	5 (50.0%)
Cerebral vascular accident cases	4 (40.0%)	6 (60.0%)	10 (50.0%)
Congestive heart failure cases	2 (66.7%)	1 (33.3%)	3 (50.0%)
Chronic kidney disease cases	2 (66.7%)	1 (33.3%)	3 (50.0%)
Liver disease cases	1 (50.0%)	1 (50.0%)	2 (50.0%)
COPD cases	2 (50.0%)	2 (50.0%)	4 (50.0%)
Connective tissue disease cases	1 (33.3%)	2 (66.7%)	3 (50.0%)
Peripheral vascular disease cases	0 (0.0%)	1 (100.0%)	1 (50.0%)
Solid tumors cases	3 (37.5%)	5 (62.5%)	8 (50.0%)
Lymphoma cases	1 (50.0%)	1 (50.0%)	2 (50.0%)
Leukemia cases	0 (0.0%)	1 (100.0%)	1 (50.0%)

Table 1**:** Compared with patients experiencing peripheral edema, those with pulmonary central edema vary in both demographic features and main clinical parameters. Central pulmonary edema patients demographic revealed a median age of 45 years, whereas peripheral edema in patients appeared at a median age of 40 years. This data suggests that central edema is likely to be found more often among elderly people. Only a few more men were in the middle rank of the classification, and while a relatively higher number of females were in the peripheral group, no gender patterns were found within the classification categories. The median body mass index (BMI) for central pulmonary edema patients was 29.5 kg/m², whereas the median for peripheral edema patients was 26.0 kg/m². This is suggestive of further evidence that obesity might be associated with the development of central pulmonary edema, because people with a higher body mass index have a greater risk for this condition. The two groups had similar rates of accompanying medical conditions. Conditions including myocardial infarction, stroke, and chronic obstructive pulmonary disease (COPD) were relatively evenly spread over the two groups; however, diabetes mellitus was significantly more frequent in the central edema group (60% versus 50%). These comorbidities are regularly seen in both peripheral and central edema, indicating that congestive heart failure and chronic kidney disease develop similarly. Higher body mass index (BMI) appears to be a key factor in the development of central pulmonary edema, suggesting that it distinguishes between the two types. It appears that patients at risk for central edema may profit from a focus on weight and any associated health issues in the therapy of pulmonary edema, because the other key criteria such as age and health comorbidities were qualitatively similar across the two groups.

Table 2: Mann-Whitney U test results:

Variable	**Group**	**Median (Interquartile range values)**	**Mann-Whitney U Statistic**	**Z-Value**	**p-value**
Age (years) comparison analysis for two groups	Peripheral vs. Central Edema study on patients	Peripheral: 40.0 (30.0–55.0). Central: 45.0 (35.0–60.0)	960.0	-1.72	0.085
Body Mass Index (kg/m²) analysis comparison	Peripheral vs. Central Edema study on patients	Peripheral: 26.0 (22.0–31.0). Central: 29.5 (25.0–34.0)	850.0	-2.30	0.021

Table 2: Peripheral edema: the median (IQR) was 40.0 years (30.0-55.0). Edema in the centre: 45 years (35.0-60.0). It was the Mann-Whitney organization Probability: 0.085 Statistics: 960.0 Z-Value: -1.72. Interpretation: It is seen that the statistical difference in age between the two cohorts is practically negligible when the alpha standard of 0.05 is utilized (p = 0.085). The age difference between those with peripheral edema and central edema is smaller, but this distinction is not statistically significant. Coronary edema: 26.0 kg/m² (range: 22.0-31.0). Dilated blood vessels in the centre: 29.5 kg/m² (range: 25.0-34.0). It was the Mann-Whitney test Figure: 850.0, Value: -2.30 p-values: 0.021. Interpretation: The p-value of 0.021 at a statistical significance of 0.05 solidly shows a valid resemblance in body mass index (BMI) between both groups. Populations dealing with central edema usually exhibit a greater body mass index than those coping with peripheral edema, demonstrated by a higher median BMI in the central edema population. This research may point to a link between the form of edema one experiences and their body composition. Age: p = 0.085 shows no statistically significant variation among the categories. Interaction between body mass index and central edema: a statistically excellent correlation was found (p = 0.021). Although age is not the most important determinant in distinguishing central from peripheral edema, our findings indicate that body mass index is essential.

Table 3: Multiple regression analysis data for the variables being tested in the study:

Predictor	B (Coefficient)	Std. Error	t	p-value
Age (in years)	0.021	0.008	2.625	0.011*
Gender (Male, Female)	-1.345	0.732	-1.837	0.069
Setting	0.568	0.850	0.668	0.506
Comorbidities				
Diabetes mellitus	1.652	0.911	1.814	0.074
Myocardial infarction	-0.436	1.200	-0.363	0.718
Cerebral vascular accident	0.934	1.010	0.925	0.358
Congestive heart failure	-1.243	1.350	-0.921	0.361
Chronic kidney disease	0.467	1.200	0.389	0.699
Liver disease	-0.543	1.450	-0.374	0.710
COPD	2.000	0.980	2.041	0.044*
Connective tissue disease	1.100	1.120	0.982	0.329
Peripheral vascular disease	-0.320	1.500	-0.213	0.832
Solid tumors	0.750	1.200	0.625	0.534
Lymphoma	-0.780	1.000	-0.780	0.437
Leukemia	0.460	1.500	0.307	0.759

Table 3: With a variety of demographic and clinical variables in view, the researchers employed multiple regression analysis to attempt to identify characteristics that might have predicted the study's outcome variable. In this chapter, the presentation of all the predicting factors: coefficients, standard errors, t-values, and p-values. 1. Years lived: The standard deviation of coefficient B is 0.021. The age of the participants is an essential predictor of the outcome variable (p = 0.011).

Table 4: ANOVA results for different variables being tested: (between-groups)

Dependent Variable	Disease (Independent Variable)	Sum of Squares (Between Groups)	df	Mean Square (Between Groups)	F-value	p-value
BMI	Diabetes Mellitus	85.00	1	85.00	2.450	0.120
BMI	Myocardial Infarction	50.00	1	50.00	1.450	0.232
BMI	Cerebral Vascular Accident	60.00	1	60.00	1.710	0.195
BMI	Congestive Heart Failure	45.00	1	45.00	1.285	0.260
BMI	Chronic Kidney Disease	50.00	1	50.00	1.450	0.232
BMI	Liver Disease	20.00	1	20.00	0.575	0.451
BMI	COPD	150.00	1	150.00	4.355	0.040*
BMI	Connective Tissue Disease	70.00	1	70.00	2.030	0.157
BMI	Peripheral Vascular Disease	25.00	1	25.00	0.725	0.397
BMI	Solid Tumors	90.00	1	90.00	2.610	0.110
BMI	Lymphoma	15.00	1	15.00	0.430	0.514
BMI	Leukemia	30.00	1	30.00	0.860	0.356
Age	Diabetes Mellitus	600.00	1	600.00	4.615	0.034*
Age	Myocardial Infarction	680.00	1	680.00	5.200	0.025*

Age	Cerebral Vascular Accident	450.00	1	450.00	3.550	0.063
Age	Congestive Heart Failure	300.00	1	300.00	2.240	0.138
Age	Chronic Kidney Disease	500.00	1	500.00	3.740	0.057
Age	Liver Disease	120.00	1	120.00	0.900	0.345
Age	COPD	620.00	1	620.00	4.810	0.031*
Age	Connective Tissue Disease	450.00	1	450.00	3.490	0.065
Age	Peripheral Vascular Disease	220.00	1	220.00	1.715	0.195
Age	Solid Tumors	540.00	1	540.00	4.100	0.046*
Age	Lymphoma	160.00	1	160.00	1.210	0.274
Age	Leukemia	280.00	1	280.00	2.140	0.147

Table 4: This ANOVA analysis offers the findings for a range of disorders, each of which is compared according to age and body mass index (BMI). The aim of this study is to discover whether a statistically significant difference in mean body mass index and age exists between groups identified by different health conditions. Body Mass Index Evaluation: Statistically significant results for diabetes: 85.00, F-value: 2.450, and p-value: 0.120. Conclusion: Those with and without diabetes mellitus show no important differences in their body mass index (p = 0.120). Infarction in the heart: 50 value, with an F-value of 1.450 and a p-value of 0.231. There was not a measurable change in the body mass index that was statistically beneficial (p = 0.232). A Brain Angioplasty: The results came out at 60.00 for Sum of Squares, 1.710 for the F-value, and 0.195 for the p-value. The analysis revealed no significant difference in body mass index that holds statistical weight (p = 0.195). Heart Failure Due to Congestive Heart Failure: A total of 45.00 is observed, with an F-value of 1.285 and a p-value of 0.260.

Getting close to what is statistically significant may imply differences based on age. COPD, The age difference for individuals with COPD is statistically significant (p = 0.031), carrying an F-value of 4.810 and a sum of squares of 620.00. Solid Cancers: The report points out that the solid-tumor populations have a 540.00 Sum of Squares, a 4.100 F-value, and a 0.046* p-value, which show a statistically significant age difference across them. Summary: As shown by the results, a consequential link with body mass index is only observed in the case of Chronic Obstructive Pulmonary Disease (COPD), which registered a contrast (p = 0.040). Results Showing Statistically Significant Age Differences: Diabetes Mellitus, Myocardial Infarction, Chronic Obstructive Pulmonary Disease (COPD), and Solid Tumors were each independently linked to older adults, according to the findings (p = 0.034, p = 0.025, p = 0.031 and p = 0.046 respectively). Chronic Kidney Disease and Cerebral Vascular Accident almost became important. The results illustrate that variations in body mass index are predominantly linked to chronic obstructive pulmonary disease (COPD), but variations in age are more widespread across a range of disorders, indicating a potential link between these conditions and demographic factors.

The outcomes indicate no statistically important changes in body mass index (p = 0.260). Chronic Nephrotic Syndrome: Five hundred values in total, with F-value at 1.450 and p-value as 0.231. There was no solid statistically significant variation in body mass index (p = 0.232). Hepatitis: These statistics are presented: an F-value of 0.575 and a p-value of 0.451. Mean of Squares: 20.00. As illustrated, there did not appear to be a major distinction in body mass index (p = 0.451). COPD: The results indicate there are important statistical differences in BMI among individuals with chronic obstructive pulmonary disease (COPD) (p<=0.05), suggesting a potential relationship between COPD and higher BMI. The squared numbers lead to a total of 150.00, with f-value of 4.355 and a p-value of 0.040*. Simultaneously, each of the other disorders) showed no meaningful differences in body mass index (BMI), with p-values substantially higher than 0.05. Results: 600.00, F-value: 4.615, p-value: 0.034., People with diabetes mellitus exhibit important differences in age (p = 0.034). Deterioration of the Heart (infarction): In its analysis, the research finds a discernible age difference in myocardial infarction cases (p = 0.025), showing an F-value of 5.200 and a sum of squares of 680.00. A Brain Angioplasty: The analysis indicated a meaningful shift in age, only scraping the surface of the 0.05 level of significance. Heart Failure Due to Congestive Heart Failure: Carrying out factor analysis led to a determination of the F-value as 2.240, a p-value of 0.138, and a Sum of Squares of 300.00. As per the findings, there is no obvious variation in age across the board (p = 0.138). Chronic Nephrotic Syndrome: A sum of 500.00, and F-value of 3.740, alongside a p-value of 0.057.

Fig. 1 shows the case of pulmonary edema in lungs as indicated in the radiological imaging analysis.

DISCUSSION:

Systemic arterial hypotension, defined as a systolic blood pressure below 90 mm Hg, is a diagnostic need for major PE [14, 15]. Therefore, CTPA findings of structurally significant PE in hemodynamically stable patients are not always indicative of severe PE and may not pose the same risk of death [14, 15]. Thromboembolism (TE) and pulmonary embolism (PE) rank third among the leading causes of mortality from cardiovascular disease, after myocardial infarction (MI) and cerebrovascular accidents (CVA) [10]. A large number of preventable deaths occur in hospitals every year due to PE [13]. Additionally, it has a high death rate because it affects the right side of the heart [13]. Therefore, in order to forecast the result and the death rate, it is essential to identify prognostic markers [13].

CONCLUSION:

Age and body mass index (BMI) stand out as key differentiating variables between individuals with central pulmonary edema and those with peripheral edema, according to the research. There was no statistically significant difference between the median ages of patients with central edema (45 years) and those with peripheral edema (40 years) ($p = 0.085$). Patients with central pulmonary edema had a much higher body mass index (29.5 kg/m² vs. 26.0 kg/m², $p = 0.021$), indicating a robust correlation between obesity and the onset of this condition. Age was also shown to be a significant outcome predictor ($p = 0.011$) in multiple regression analysis, with chronic obstructive pulmonary disease (COPD) suggesting a considerable association ($p = 0.044$). The ANOVA findings further demonstrated that age and COPD are important factors affecting the variability in BMI across various comorbidities. When it comes to treating and preventing central pulmonary edema, the results indicate that controlling weight and associated health problems may be helpful.

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